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Regeneration on Aspen Clearcuts in Northwestern Colorado

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Clearcutting mature aspen, on 5-acre blocks, resulted in 18,000 sprouts per acre, and nearly full stocking of half-milacre plots after one growing season. Two years later, sprouts averaged about 8,000 per acre, and mean height of the tallest stem was 4.4 feet. Further normal declines in numbers of sprouts are expected but losses may be accelerated by trampling and browsing.

Keywords: *Populus tremuloides*, clearcutting, regeneration, animal damage

Quaking aspen (*Populus tremuloides* Michx.) is the most abundant deciduous tree in the central Rocky Mountains. Aspen dominated plant communities comprise more than 4 million acres of commercial forest land in the Rockies, with almost 2.3 million acres in Colorado (Green and Setzer 1974). Much additional acreage is occupied by noncommercial stands of aspen; the tree also commonly occurs in mixtures with various conifer species (Baker 1925).

In addition to wood products, aspen provides habitat for many wild birds and mammals and may be essential for some species (Armstrong 1977, Flack 1976, Gruell and Loope 1974, Reynolds 1969). Aspen forests also produce much forage, offer shelter for domestic livestock, and are major contributors to the pleasing appearance of vegetation mosaics so prized in the Rocky Mountain states.

Aspen usually reproduces vegetatively by sprouting after an existing stand is destroyed (Jones 1975). For centuries, fire apparently was the common regenerative force, but in recent years, wildfires have been virtually eliminated. Thus, most of the aspen stands in the central Rockies are mature and overmature. Clearcut logging, another effective regenerative procedure, has not been used extensively in aspen, primarily because of low demand for its wood products.

Realization that mature and overmature aspen now prevalent may be replaced by other plant communities has increased interest in determining its values for various uses. Aspen as wildlife habitat is of particular interest, because little quantified information is available about aspen-wildlife relationships, except that the trees, individually and in stands, appear to be important to many species.

In a larger study,[2] one method of regeneration—clearcutting in 5-acre blocks—was evaluated for its effects on the suitability of an aspen stand as habitat for selected game and nongame wildlife species. This note reports on the short-term response of aspen regeneration to the clearcutting.

Study Area

The work was conducted near Slater Creek, on the Bears Ears Ranger District of the Routt National Forest, in northwest Colorado. The study area, on a west facing slope, consisted of about 45 contiguous acres of aspen encompassing all or parts of several clones. Elevations averaged about 8,200 feet, and topography was undulating, with occasional, steep pitches typical of slumpy landforms. Soils were deep Argic Pachic Cryoborolls.[3]

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[2] *Data on file at the Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colo.*

[3] *Soil data on file at the Supervisor's Office, Routt National Forest, Steamboat Springs, Colo.*

The site was occupied by a mature to overmature stand of aspen, ranging from less than 1 inch to more than 20 inches d.b.h. The understory contained small, occasionally dense patches of chokecherry (*Prunus virginiana* L.) and serviceberry (*Amelanchier alnifolia* Nutt.), and scattered snowberry (*Symphoricarpos oreophilus* Gray). Herbaceous cover was nearly complete (fig. 1). The stand represented elements of the *Populus tremuloides/Symphoricarpos oreophilus* and *P. tremuloides/Thalictrum fendleri* habitat types described by Hoffman and Alexander (1980).

The study area was assumed to be suitable spring, summer, and fall habitat for mule deer (*Odocoileus hemionus* Rafinesque), elk (*Cervus canadensis* Erxleben), and other game and nongame birds and mammals that typically utilize such sites. Domestic sheep also grazed the site each summer.

Methods

For the regeneration study reported here, data were collected from the four, square, 5-acre blocks to be clearcut within the 45-acre study area. Sampling was conducted in square, 1-acre plots centered in each 5-acre block. The 1-acre plots were gridded to provide 25 sampling sites spaced 52 feet apart.

Figure 1.—Typical view on Bears Ears study area before clearcutting.

Pretreatment overstory data were obtained from 2-milacre, circular subplots centered at each of the 25 sampling points in the 1-acre plots. Numbers, diameters and heights of all trees 1 inch or larger were recorded, and increment cores were taken to determine the age of each sample tree. In addition, aspen sprouts and conifers were counted, and their heights were measured in each subplot. Canopy intercept was recorded at subplot centers using a point-sampling device.

Pretreatment sampling was completed in July 1977. Blocks were clearcut, and the downed trees were piled around the perimeter of each block, in early October. All trees were cut except for two mature individuals per acre that were retained for wildlife use. Tractor yarding disturbed the surface of much of the clearcut area, but care was taken to protect aspen roots by keeping the tractor blade above ground level. Several attempts to burn the piled logs in succeeding years were mostly unsuccessful.

Posttreatment data were collected each year in circular, half-milacre, permanently marked plots at the locations described.

Data were subjected to analyses of variance, and means were separated according to Tukey (Snedecor 1961) as appropriate. Confidence intervals were used to indicate reliability of these mean values.

Results and Discussion

The original stand averaged about 180 square feet per acre of basal area distributed on 531 stems per acre (table 1). About half of the trees, 281 per acre, were in the merchantable size classes (≥5.5 inches d.b.h.). This was also the class considered to include the mature and overmature trees (≥70 years). Site index was estimated to be 75 according to curves published by Jones (1967).

The stand was mostly intact, with few down trees and snags. Dead trees totaled 25 per acre, with a mean diameter of 6.1 inches d.b.h.. Several mature conifers were present on the blocks, and a few small, heavily browsed subalpine fir (*Abies lasiocarpa* (Hook.) Nutt.) were scattered through the stand.

Percentages of stems containing decay were about evenly distributed among diameter classes, but the total basal area of defective material was obviously much greater among the larger trees.

Although smaller trees constituted almost 50% of the total number, it is highly unlikely that they would have succeeded as stand replacements as the older trees died, because many were badly deformed and most had very sparse canopies. Also, most understory sprouts were multistemmed or bushy and in generally poor condition.

Few sprouts were evident in July 1978, the year after clearcutting (fig. 2). By September, the estimated number was 18,120 ± 3,280 (table 2). Up to 42 sprouts per half-milacre plot were counted; 99% of the plots were stocked. Virtually all of the sprouts produced during the first three growing seasons were present the first year after clearcutting.

Although impressive, the number is much smaller than those described in Utah by Baker (1925), up to

Table 1.—Characteristics of a stand of aspen trees before clearcutting, on the Bears Ears Ranger District, northwestern Colorado[1]

Characteristic	Diameter class (inches)				
	1.0-1.9	2.0-5.4	5.5-10.4	10.5-18.8	All trees
Number per acre	95 ± 34	155 ± 39	158 ± 36	123 ± 34	531 ± 31
Percent with decay	30	35	25	29	30
Stocking (percent)[2]	14 ± 5	24 ± 10	30 ± 10	21 ± 2	67 ± 13
Age (years)	16 ± 2	47 ± 7	67 ± 4	92 ± 6	66 ± 2
Height (feet)	11 ± 1	27 ± 3	59 ± 3	74 ± 2	49 ± 3
D.b.h. (inches)	1.3 ± 0.1	3.8 ± 0.3	7.7 ± 0.3	12.7 ± 0.6	6.7 ± 0.6
Basal area (square feet per acre)	1.0 ± 0.3	12.7 ± 3.7	50.4 ± 12.6	116.4 ± 3.4	180.5 ± 33.7
Percent canopy cover					73 ± 5
Sprouts per acre					473 ± 123

[1]*Confidence intervals* = $\overline{X} \pm t.05\ (S\overline{X})$
[2]*Circular, 2-milacre plots containing one or more trees.*

Figure 2.—July 1978 view of 5-acre block that was clearcut and yarded in October 1977.

Table 2.—Characteristics of sprouts before and after clearcutting in October 1977 in an aspen stand, on the Bears Ears Ranger District, northwestern Colorado[1]

Characteristic	Before cutting	After cutting		
	1977	1978	1979	1980
Number per acre				
Total	473 a	18,120 b	13,200 c	8,160 d
Current year	1 a	18,120 b	580 c	100 d
Discolored or decayed, (percent)	19 a	1 b	7 b	20 a
Stocking (percent)[2]	23 a	99 b	93 c	81 d
Height, (feet)[3]	1.4 a	1.9 a	3.4 b	4.4 c

[1]*Means within each characteristic followed by the same letter are not significantly different at P = 0.05.*
[2]*Circular half-milacre plots containing one or more sprouts.*
[3]*Height of the tallest sprout in each sampling plot.*

110,000 per acre; Sampson (1919), 85,000 per acre; or Schier and Smith (1979), 52,000 per acre, but is reasonably close to the 14,000 found by Jones (1975) in Arizona. The number is also much lower than the 30,000 first-year sprouts per acre estimated on a study area in southwestern Colorado.[2]

After three growing seasons, sprouts had declined to 8,160 ± 1,560 per acre, a loss of 55%, and stocking had declined to 81 percent (table 2). Although many sprouts were growing well, many others were overtopped, broken, or scarred, and unlikely to survive much longer (fig. 3).

Heights of dominant sprouts averaged 4.4 ± 0.4 feet after three growing seasons, with the tallest measuring 8.9 feet (table 2). Third-year heights compared favorably with 4-year heights, of 3.4 feet in Utah, reported by Sampson (1919); 4.2 feet by Baker (1925); and 4.6 feet on a southwestern Colorado study area.[2] Bears Ears sprout growth, however, fell far short of the 4-year 10.5 foot average height reported on a better site, in Arizona (Jones 1975).

Several factors have contributed to the decline in numbers of sprouts including damage by animals (table 3). Browsing, thought to be primarily by sheep, has declined since the first year after clearcutting and is considered relatively unimportant to date. However, all sprouts are vulnerable to trampling, and many are still susceptible to damage from browsing. Sampson (1919) and Smith et al. (1972) reported adverse effects of sheep on aspen regeneration. Damage from meadow voles (*Microtus montanus* Peale), first noted in 1979, increased markedly in 1980. Vole girdling usually killed the trees.

Many sprouts were decayed or had prominent stem discoloration which appeared to precede decay (table 2). Nearly all of the affected stems had basal lesions, or callused basal injuries (fig. 4). These could result from factors such as shoot breakage, but more likely are caused by snow bending, or overriding by bands of sheep.

Figure 3.—Above average sprouts during their third growing season.

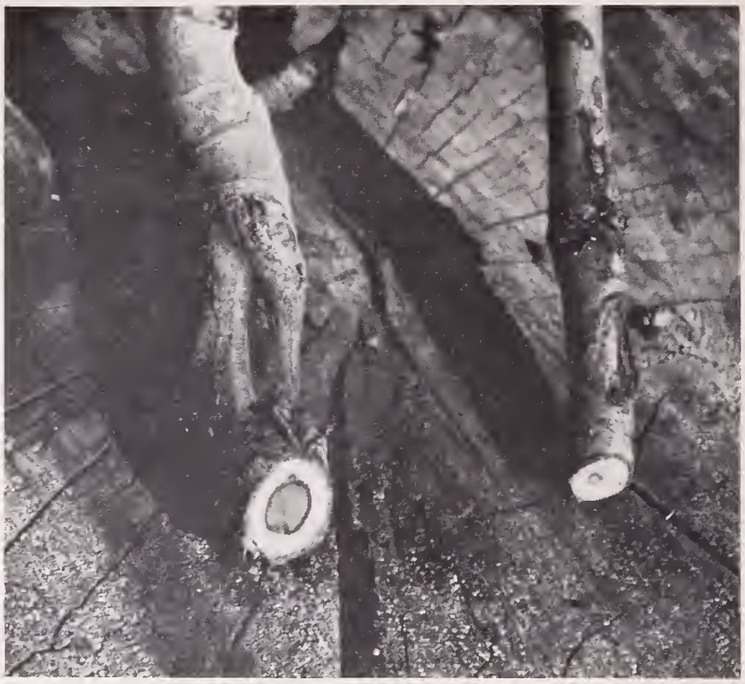

Figure 4.—Aspen sprouts showing basal injuries and associated stem discoloration.

Table 3.—Damage (in percent) to aspen sprouts in blocks clearcut in 1977, on the Bears Ears Ranger District, northwestern Colorado

Category[1]	1978	1979	1980
Browsing	23	14	12
Trampling	0	4	1
Girdling	0	< 1	7
Clipping	0	0	3
Basal injury[2]	1	12	19

[1]*Browsing and trampling by sheep, deer, and elk; girdling by voles; clipping by hares and rabbits (Leporidae).*

[2]*Causes uncertain, possible bending by snow, or overriding by sheep.*

Declines in numbers of stems must occur during maturation of aspen stands. Although these areas had more that 8,000 sprouts per acre after three growing seasons, the stocking is still susceptible to hazards such as sheep, which could, if improperly managed, severely reduce stocking or result in a stand of deformed trees.

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